

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (currently amended) An optical node device comprising a switching unit that switches an optical signal, wherein a preset section in which data transmission is possible without 3R (Reshaping, Retiming, and Regeneration) relay is defined as a 3R section, the optical node device comprising:

a storing unit which stores 3R section information corresponding to topology information of an optical network to which the optical node device itself belongs; and

a determining unit which determines autonomously whether the optical node device itself is an optical node device that implements 3R relay when setting an optical path passing through the optical node device itself, with reference to the 3R section information stored in the storing unit which stores the 3R section information.

2. (original) An optical node device that switches an optical signal, wherein a preset section in which data transmission is possible without 3R relay is defined as a 3R section, an optical node device, being a source of a setting request for an optical path is defined as a source node, and an optical node device at an end point of the optical path is defined as a destination node, the optical node device comprising:

a storing unit which stores 3R section information corresponding to topology information of an optical network to which the optical node device itself belongs;

an identifying unit which identifies another optical node device which implements 3R relay among other optical node devices through which an optical path from the optical node device itself to the destination node passes with reference

to the 3R section information stored in the storing unit, when the optical node device itself is the source node; and

a unit which requests 3R relay be implemented in the other optical node device identified by the identifying unit, when setting an optical path in which the optical node device itself is the source node.

3. (canceled)

4. (currently amended) An optical node device according to claim 1 ~~or claim 3~~, wherein when an optical node device, being a source of a setting request for an optical path, is the source node, an optical node device at an end point of the optical path is the destination node, and the optical path is bi-directional, an optical path directed away from the source node toward the destination node is defined as a downstream optical path, and an optical path directed away from the destination node toward the source node is defined as an upstream optical path, and when the optical path is a bi-directional optical path, the determining unit is provided with a unit which decides which optical node device implements 3R relay in both the downstream optical path and the upstream optical path.

5. (original) An optical node device according to claim 2, wherein when an optical node device, being a source of a setting request for an optical path, is a source node, an optical node device at an end point of the optical path is a destination node, and the optical path is bi-directional, an optical path directed away from the source node toward the destination node is defined as a downstream optical path, and an optical path directed away from the destination node toward the

source node is defined as an upstream optical path, and when the optical path is a bi-directional optical path, the identifying unit is provided with a unit which decides which optical node device implements 3R relay in both the downstream optical path and the upstream optical path.

6. (currently amended) An optical node device according to claim 1, ~~claim 3, or claim 4~~, wherein an optical node device at a start point of the 3R section is defined as a 3R source node, an optical node device at an end point of the 3R section is defined as a 3R destination node, an optical node device, being a source of a setting request for an optical path, is defined as a source node, and an optical node device at an end point of the optical path is defined as the destination node, and

when one optical node device is a 3R source node of any one of a plurality of different 3R sections overlapping on an optical path that passes through the one optical node device, and the one optical node device is not a 3R source node or 3R destination node of other 3R sections,

the determining unit is provided with:

a comparing unit which compares the number of 3R relay implementations for both the case where the one optical node device functions as a 3R source node and where the one optical node device does not function as a 3R source node, with reference to the 3R section information related to an optical path from the one optical node device to the destination node; and

a unit which, when the number of 3R implementations in the case where the one optical node device functions as a 3R source node is less than the number of 3R implementations in the case where the one optical node device does not function as

a 3R source node, decides that the one optical node device is an optical node device that implements 3R relay based on a comparison result from the comparing unit.

7. (currently amended) An optical node device according to claim 2 ~~or claim 5~~, wherein an optical node device at a start point of the 3R section is defined as a 3R source node, an optical node device at an end point of the 3R section is defined as a 3R destination node, an optical node device, being a source of a setting request for an optical path, is defined as a source node, and an optical node device at an end point of the optical path is defined as a destination node, and

when one optical node device is a 3R source node of any one of a plurality of different 3R sections overlapping on an optical path that passes through the one optical node device, and the one optical node device is not a 3R source node or 3R destination node of other 3R sections,

the identifying unit is provided with:

a comparing unit which compares the number of 3R relay implementations for both the case where the one optical node device functions as a 3R source node and where the one optical node device does not function as a 3R source node, with reference to the 3R section information related to an optical path from the one optical node device to the destination node; and

a unit which, when the number of 3R implementations in the case where the one optical node device functions as a 3R source node is less than the number of 3R implementations in the case where the one optical node device does not function as a 3R source node, decides that the one optical node device is an optical node device that implements 3R relay based on a comparison result from the comparing unit.

8. (currently amended) An optical node device according to claim 1, ~~claim 3, or claim 4~~, wherein an optical node device, being a source of a setting request for an optical path, is defined as a source node, and an optical node device at an end point of the optical path is defined as a destination node, and

when one optical node device is an optical node device corresponding to a 3R destination node, and is not a destination node,

the determining unit is provided with a unit which decides that the one optical node device is an optical node device that implements 3R relay by using the one optical node device as a 3R source node, and a next hop optical node device as a 3R destination node.

9. (currently amended) An optical node device according to claim 2 ~~or claim 5~~, wherein an optical node device, being a source of a setting request for an optical path, is defined as a source node, and an optical node device at an end point of the optical path is defined as a destination node, and

when one optical node device is an optical node device corresponding to a 3R destination node, and is not a destination node,

the identifying unit is provided with a unit which decides that the one optical node device is an optical node device that implements 3R relay by using the one optical node device as a 3R source node, and a next hop optical node device as a 3R destination node.

10. (currently amended) An optical node device according to claim 1, ~~claim 3, or claim 4~~, wherein an optical node device at a start point of the 3R section is defined as a 3R source node, and

when one optical node device does not belong to any one of 3R sections having a 3R source node on an optical path that passes through the one optical node device,

the determining unit is provided with a unit which decides that the one optical node device is an optical node device that implements 3R relay by using the one optical node device as a 3R source node, and a next hop optical node device of the one optical node device as a 3R destination node.

11. (currently amended) An optical node device according to claim 2 ~~or claim 5~~, wherein an optical node device at a start point of the 3R section is defined as a 3R source node, and

when one optical node device does not belong to any one of 3R sections having a 3R source node on an optical path that passes through the one optical node device, the identifying unit is provided with a unit which decides that the one optical node device is an optical node device that implements 3R relay by using the one optical node device as a 3R source node, and a next hop optical node device of the one optical node device as a 3R destination node.

12. (currently amended) An optical node device according to claim 1, ~~claim 3, or claim 4~~, further comprising a unit which, when one optical node device is a 3R source node in an upstream optical path, and is not a destination node, and the one optical node device is not a 3R destination node in the upstream optical path, transmits a message in order to transmit information to a previous hop optical node device in the upstream optical path that the previous hop optical node device is a 3R source node which uses the one optical node device as a 3R destination node,

wherein the determining unit is provided with a unit which decides that the optical node device itself is a 3R source node in the upstream optical path with an optical node device which has sent the message as a 3R destination node when the optical node device itself receives the message in the upstream optical path.

13. (currently amended) An optical node device according to claim 2 ~~or claim 5~~, further comprising a unit which, when one optical node device is a 3R source node in an upstream optical path, and is not a destination node, and the one optical node device is not a 3R destination node in the upstream optical path, transmits a message in order to transmit information to a previous hop optical node device in the upstream optical path that the previous hop optical node device is a 3R source node which uses the one optical node device as a 3R destination node,

wherein the identifying unit is provided with a unit which decides that the optical node device itself is a 3R source node in the upstream optical path with an optical node device which has sent the message as a 3R destination node when the optical node device itself receives the message in the upstream optical path.

14. (currently amended) An optical node device according to claim 1, ~~that switches an optical signal, wherein a preset section in which data transmission is possible without 3R relay is defined as a 3R section,~~ an optical node device at a start point of the 3R section is defined as a 3R source node, and an optical node device at an end point of the 3R section is defined as a 3R destination node, ~~the optical node device comprising:~~

[[a]] the storing unit which stores, as the 3R section information, information of a 3R section in which the optical node device itself is a 3R source node[[:]], and

~~a unit which~~, when the optical node device itself is not a destination node on receiving a message, contained in a setting request for an optical path, indicating that the optical node device itself is a 3R destination node, the determining unit refers to the storing unit, and when the optical node device itself is a 3R source node in the optical path, determines that the optical node device itself is an optical node device that implements 3R relay, and transmits a message to an optical node device, corresponding to a 3R destination node of a 3R section in an optical path in which the optical node device itself is a 3R source node, in order to transmit that the optical node device corresponding to the 3R destination node is a 3R destination node.

15. (original) An optical node device according to claim 14, further comprising a unit which, when the optical node device itself is not a destination node on receiving the message, contained in the setting request for the optical path, indicating that the optical node device itself is the 3R destination node, refers to the storing unit, and when the optical node device itself is not a 3R source node in the optical path, determines that the optical node device itself is an optical node device that implements 3R relay as a 3R source node using a next hop optical node device as a 3R destination node, and transmits a message to the next hop optical node device in order to transmit that the next hop optical node device is a 3R destination node.

16. (currently amended) An optical node device according to claim 1, ~~that switches an optical signal, wherein when a preset section in which data transmission is possible without 3R relay is a 3R section~~, an optical node device at a start point of the 3R section is a 3R source node, an optical node device at an end point of the 3R section is a 3R destination node, an optical node device, being a source of a setting

request of an optical path, is a source node, an optical node device at an end point of the optical path is a destination node, and the optical path is a bi-directional optical path, an optical path directed away from the source node toward the destination node is defined as a downstream optical path, and an optical path directed away from the destination node toward the source node is defined as an upstream optical path, ~~the optical node device comprising:~~

[[a]] the storing unit which stores, as the 3R section information, information of a 3R section in which the optical node device itself is a 3R source node and a 3R destination node[;]],

the determining unit is provided with: a unit which, when the optical node device itself is not a destination node on receiving a message, contained in an optical path setting request, indicating that the optical node device itself is a 3R destination node in the downstream optical path, refers to the storing unit, and when the optical node device itself is a 3R source node in the downstream optical path, determines that the optical node device itself is an optical node device that implements 3R relay, and transmits a message to an optical node device corresponding to a 3R destination node of a 3R section in the downstream optical path in which the optical node device itself is a 3R source node, in order to transmit that the optical node device corresponding to the 3R destination node is a 3R destination node; and

a unit which determines that the optical node device itself is an optical node device that implements 3R relay in the upstream optical path on receiving a message, contained in an optical path setting request, indicating that the optical node device itself is a 3R source node in the upstream optical path and which, when the optical node device itself is not a destination node, refers to the storing unit, and

when the optical node device itself is a 3R destination node in the upstream optical path, transmits a message to an optical node device corresponding to a 3R source node in the upstream optical path in which the optical node device itself is a 3R destination node, in order to transmit that the optical node device corresponding to the 3R source node is a 3R source node.

17. (original) An optical node device according to claim 16, further comprising:

a unit which, when the optical node device itself is not a destination node on receiving the message, contained in the optical path setting request, indicating that the optical node device itself is the 3R destination node in the downstream optical path, refers to the storing unit, and when the optical node device itself is not a 3R source node in the downstream optical path, determines that the optical node device itself is an optical node device that implements 3R relay using the optical node device itself as a 3R source node and a next hop optical node device in the downstream optical path as a 3R destination node, and transmits a message to the next hop optical node device in order to transmit that the next hop optical node device is a 3R destination node of the optical node device itself; and

a unit which determines that the optical node device itself is an optical node device that implements 3R relay in the upstream optical path on receiving the message, contained in the optical path setting request, indicating that the optical node device itself is the 3R source node in the upstream optical path, and which when the optical node device itself is not a destination node, refers to the storing unit, and when the optical node device itself is not a 3R destination node in the upstream optical path, transmits a message to a previous hop optical node device in the upstream optical path, in order to transmit that the previous hop optical node

device is a 3R source node using the optical node device itself as a 3R destination node.

18. (canceled)

19. (original) An optical node device that switches an optical signal, comprising an acquiring unit which requests a network control device managing an optical network to which the optical node device itself belongs to provide 3R section information corresponding to topology information of the optical network, and acquires the 3R section information.

20. (original) An optical node device according to claim 19, wherein the acquiring unit is provided with a unit which selects and stores at least a part of information associated with the optical node device itself from the 3R section information acquired.

21. (currently amended) An optical node device according to claim 19, that switches an optical signal, wherein a preset section in which data transmission is possible without 3R relay is defined as a 3R section, and the optical node device comprising is further provided with

~~an acquiring unit which requests a network control device that manages an optical network to which the optical node device itself belongs, for 3R section information corresponding to topology information of the optical network to which the optical node device itself belongs and acquires the 3R section information; and~~

——a unit which stores the 3R section information acquired by the acquiring unit, and advertises the 3R section information to other optical node devices.

22. (currently amended) An optical node device according to claim 19, that ~~switches an optical signal~~, wherein a preset section in which data transmission is possible without 3R relay is defined as a 3R section, an optical node device, being a source of a setting request for an optical path, is defined as a source node, and an optical node device at an end point of the optical path is defined as a destination node, ~~the optical node device comprising:~~

[[an]] the acquiring unit ~~which requests~~ [[a]] the network control device ~~managing an optical network to which the optical node device itself belongs for the~~ 3R section information ~~corresponding to topology information of the optical network to which the optical node device itself belongs when the optical node device itself is~~ a source node, and acquires the 3R section information[[;]], and

the optical node device is further provided with a unit which stores the 3R section information acquired by the acquiring unit, and transmits the 3R section information to other optical node devices contained in an optical path up to the destination node when the optical node device itself is used as the source node.

23. (currently amended) An optical node device according to claim 19, that ~~switches an optical signal~~, wherein a preset section in which data transmission is possible without 3R relay is defined as a 3R section, an optical node device, being a source of a setting request for an optical path, is defined as a source node, and an optical node device at an end point of the optical path is defined as a destination node, ~~the optical node device comprising:~~

~~[[an]] the acquiring unit which requests [[a]] the network control device managing an optical network to which the optical node device itself belongs for the 3R section information corresponding to topology information of the optical network to which the optical node device itself belongs when the optical node device itself is a source node, and acquires the 3R section information[[;]].~~

the optical node device is further provided with:

an advertising unit which stores the 3R section information acquired by the acquiring unit, and advertises the 3R section information to other optical node devices;

a determining unit which determines whether an advertisement by the advertising unit is associated with an optical path that passes through the optical node device itself;

a unit which discards the advertisement when a determination result of the determining unit indicates that the advertisement is not associated with the optical path that passes through the optical node device itself; and

a unit which stores contents of the advertisement when the determination result of the determining unit indicates that the advertisement is associated with the optical path which passes through the optical node device itself.

24. (currently amended) An optical node device according to claim 1, ~~that switches an optical signal, wherein a preset section in which data transmission is possible without 3R relay is defined as a 3R section~~, an optical node device at a start point of the 3R section is defined as a 3R source node, an optical node device at an end point of the 3R section is defined as a 3R destination node, an optical node device, being a source of a setting request for an optical path, is defined as a source

node, and an optical node device at an end point of the optical path is defined as a destination node, ~~the optical node device comprising:~~

[[a]] the storing unit which stores, as the 3R section information, information of the number of hops H between the optical node device itself and a 3R destination node in a 3R section to which the optical node device itself belongs~~[[:]], and~~
~~—— a determining unit which determines autonomously whether the optical node device itself implements 3R relay of an optical signal transmitted from a 3R source node in the 3R section to which the optical node device itself belongs,~~

wherein the determining unit determines that 3R relay of an optical signal transmitted from a 3R source node in the 3R section to which the optical node device itself belongs is implemented, if $T > TH_T$, and $H < TH_H$, where T is the number of 3R trunks that the optical node device itself has, TH_T is a threshold value of the number of vacant 3R trunks, and TH_H is a threshold value of the number of hops up to the 3R destination node.

25 – 34. (canceled)

35. (currently amended) An optical node device according to claim 24,
~~comprising a switching unit which switches an optical signal, wherein a preset section in which data transmission is possible without 3R (Reshaping, Retiming and Regenerating) relay is defined as a 3R section, an optical node device at a start point of the 3R section is defined as a 3R source node, an optical node device at an end point of the 3R section is defined as a 3R destination node, an optical node device, being a source of a setting request for an optical path, is defined as a source node, and an optical node device at an end point of the optical path is defined as a~~

~~destination node, and wherein the setting request for the optical path contains labels for specifying wavelengths to be used in order from the source node at the time of switching from the source node to the destination node, and the labels are deleted one by one each time a wavelength is set, and~~

the switching unit is provided with a wavelength conversion unit or a 3R relay unit, and

~~the optical node device further comprises:~~

~~a unit which stores information of the number of hops H between the optical node device itself and a 3R destination node of a 3R section to which the optical node device itself belongs; and~~

~~a determining unit which determines autonomously whether the optical node device itself implements 3R relay of an optical signal transmitted from a 3R source node in the 3R section to which the optical node device itself belongs, and~~

the determining unit determines that 3R relay of an optical signal transmitted from a 3R source node in the 3R section to which the optical node device itself belongs is implemented if $T > TH_T$ and ($H < TH_H$ and $L < TH_L$), where T is the number of wavelength conversion trunks provided in the wavelength conversion unit or the number of the 3R trunks provided in the 3R relay unit, TH_T is a threshold value of the number of vacant wavelength conversion trunks or the number of vacant 3R trunks, ~~TH_H is a threshold value of the number of hops up to the 3R destination node~~, L is the number of remaining labels, and TH_L is a threshold value of the number of the remaining labels.

36. (currently amended) An optical node device according to claim 24, ~~comprising a switching unit which switches an optical signal, wherein a preset~~

~~section in which data transmission is possible without 3R relay is defined as a 3R section, an optical node device at a start point of the 3R section is defined as a 3R source node, an optical node device at an end point of the 3R section is defined as a 3R destination node, an optical node device, being a source of a setting request for an optical path, is defined as a source node, and an optical node device at an end point of the optical path is defined as a destination node, and~~

~~——wherein the setting request for the optical path contains labels for specifying wavelengths to be used in order from the source node at the time of switching from the source node to the destination node, and the labels are deleted one by one each time a wavelength is used, and~~

~~the switching unit is provided with a wavelength conversion unit or a 3R relay unit, and~~

~~——the optical node device further comprises:~~

~~——a unit which stores information of the number of hops H between the optical node device itself and a 3R destination node of a 3R section to which the optical node device itself belongs; and~~

~~——a determining unit which determines autonomously whether the optical node device itself implements 3R relay of an optical signal transmitted from a 3R source node in the 3R section to which the optical node device itself belongs, and~~

~~the determining unit determines that 3R relay of an optical signal transmitted from a 3R source node in the 3R section to which the optical node device itself belongs is implemented if $T > TH_T$ and $(H < TH_H \text{ or } L < TH_L)$, where T is the number of wavelength conversion trunks provided in the wavelength conversion unit or the number of the 3R trunks provided in the 3R relay unit, TH_T is a threshold value of the number of vacant wavelength conversion trunks or the number of vacant 3R~~

trunks, TH_H is a threshold value of the number of hops up to the 3R destination node, L is the number of remaining labels, and TH_L is a threshold value of the number of the remaining labels.

37. (original) An optical node device according to claim 35 or claim 36, further comprising a unit which determines that the optical node device itself does not implement 3R relay regardless of a result determined by the determining unit when the optical node device itself belongs to a 3R section in which a 3R destination node is the destination node.

38. (currently amended) An optical node device according to claim 24, ~~comprising a switching unit which switches an optical signal, wherein when a preset section in which data transmission is possible without 3R relay is a 3R section, an optical node device at a start point of the 3R section is a 3R source node, an optical node device at an end point of the 3R section is a 3R destination node, an optical node device, being a source of a setting request for an optical path, is a source node, an optical node device at an end point of the optical path is a destination node, and the optical path is bi-directional, an optical path directed away from the source node toward the destination node is defined as a downstream optical path, and an optical path directed away from the destination node toward the source node is defined as an upstream optical path, and~~

the setting request for the optical path contains labels for specifying wavelengths to be used in order from the source node at the time of switching from the source node to the destination node, and the labels are deleted one by one each time a wavelength is set, and

the switching unit is provided with a wavelength conversion unit or a 3R relay unit, and

~~the optical node device further comprises:~~

[[a]] the storing unit ~~which~~ stores information of the number of hops H between the optical node device itself and a 3R destination node of a 3R section to which the optical node device itself belongs in the upstream optical path[[]], and

~~a determining unit which determines autonomously whether the optical node device itself implements 3R relay of an optical signal transmitted from a 3R source node in the 3R section to which the optical node device itself belongs in the upstream optical path, and~~

the determining unit determines that 3R relay of an optical signal transmitted from a 3R source node in the 3R section to which the optical node device itself belongs in the upstream optical path is implemented if $T > TH_T$ and ($H < TH_H$ and $L > TH_L$), where T is the number of wavelength conversion trunks provided in the wavelength conversion unit or the number of the 3R trunks provided in the 3R relay unit, TH_T is a threshold value of the number of vacant wavelength conversion trunks or the number of vacant 3R trunks, ~~TH_H is a threshold value of the number of hops up to the 3R destination node~~, L is the number of remaining labels, and TH_L is a threshold value of the number of the remaining labels.

39. (currently amended) An optical node device according to claim 24, ~~comprising a switching unit which switches an optical signal, wherein when a preset section in which data transmission is possible without 3R relay is a 3R section, an optical node device at a start point of the 3R section is a 3R source node, an optical node device at an end point of the 3R section is a 3R destination node, an optical~~

~~node device, being a source of a setting request for an optical path, is a source node, an optical node device at an end point of the optical path is a destination node, and the optical path is bi-directional, an optical path directed away from the source node toward the destination node is defined as a downstream optical path, and an optical path directed away from the destination node toward the source node is defined as an upstream optical path, and~~

the setting request for the optical path contains labels for specifying wavelengths to be used in order from the source node at the time of switching from the source node to the destination node, and the labels are deleted one by one each time a wavelength is set, and

the switching unit is provided with a wavelength conversion unit or a 3R relay unit, and

~~the optical node device further comprises:~~

[[a]] the storing unit ~~which~~ stores information of the number of hops H between the optical node device itself and a 3R destination node of a 3R section to which the optical node device itself belongs in the upstream optical path[[;]], and

~~a determining unit which determines autonomously whether the optical node device itself implements 3R relay of an optical signal transmitted from a 3R source node in the 3R section to which the optical node device itself belongs in the upstream optical path, and~~

the determining unit determines that 3R relay of an optical signal transmitted from a 3R source node in the 3R section to which the optical node device itself belongs in the upstream optical path is implemented if $T > TH_T$ and ($H < TH_H$ or $L > TH_L$), where T is the number of wavelength conversion trunks provided in the wavelength conversion unit or the number of the 3R trunks provided in the 3R relay

unit, TH_T is a threshold value of the number of vacant wavelength conversion trunks or the number of vacant 3R trunks, TH_H is a threshold value of the number of hops up to the 3R destination node, L is the number of remaining labels, and TH_L is a threshold value of the number of the remaining labels.

40. (original) An optical node device according to claim 38 or claim 39, further comprising a unit which determines that the optical node device itself does not implement 3R relay regardless of a result determined by the determining unit when the optical node device itself belongs to a 3R section in which a 3R destination node is the destination node.

41 – 88. Cancelled